NASA
National Aeronautics and
Space Administration

Dryden Flight Research Center
P.O. Box 273
Edwards, California 93523
AC 805-258-2004
FAX 805-258-3088
ed@trc.dfrc.nasa.gov

Information Summaries

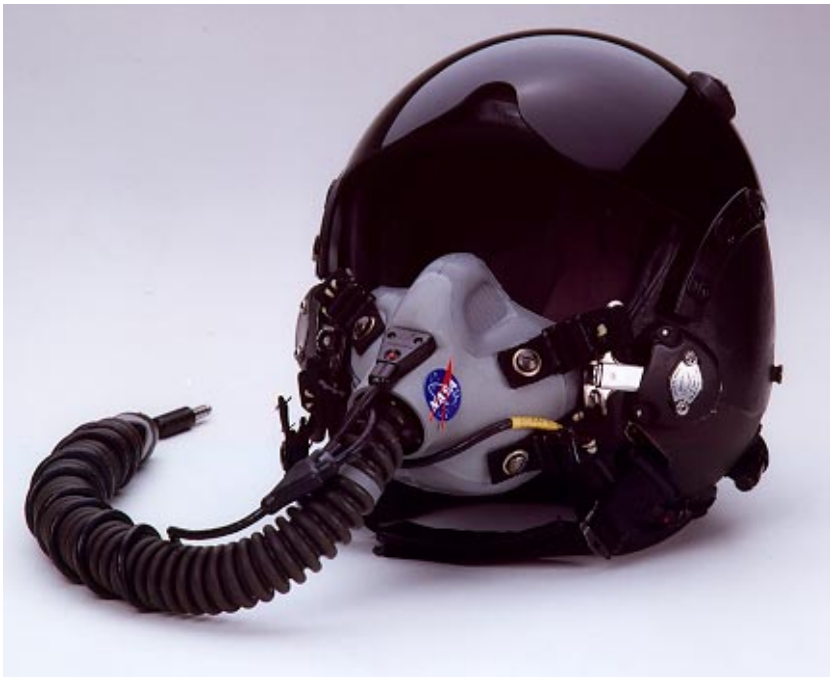
IS-97/08-DFRC-04

Aerospace Careers: Life Support Equipment Branch

The safety of flight crews is a primary concern in aeronautical research, where aircraft are being pushed to design limits to meet NASA's quest for knowledge.

At NASA's Dryden Flight Research Center, members of the Life Support Equipment Branch carry out tasks every day that are critical to the safety of flight crews. As part of the Life Support Group, the branch is an essential part of crew safety and plays a part in every aircraft operation at the center. The branch takes care of the personal equipment (helmets, oxygen masks, flight clothing, G-suits, parachutes, and other survival items) used by all pilots and aircraft crewmembers to create a safe flying environment and help them survive in an emergency situation.

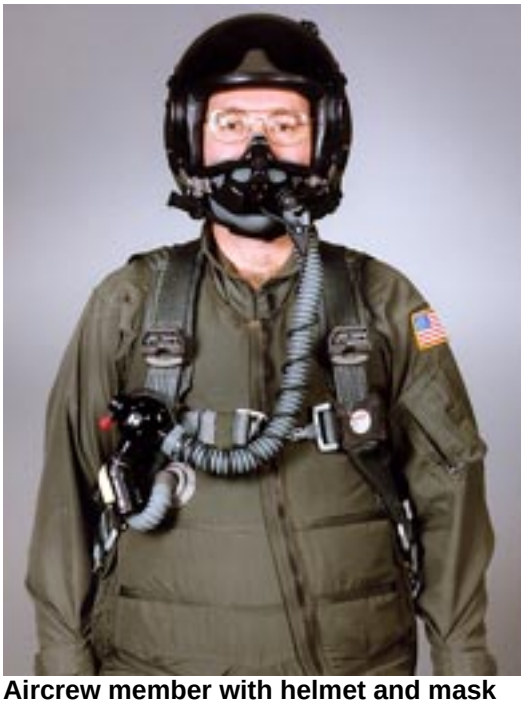
When a NASA pilot suits up for a research flight, the Life Support Equipment Branch is involved with nearly every article of clothing and flight equipment. The branch issues and maintains the items, and — when necessary — repairs or replaces them. The branch also helps develop and test new items of flight crew equipment.



Helmet and mask assembly

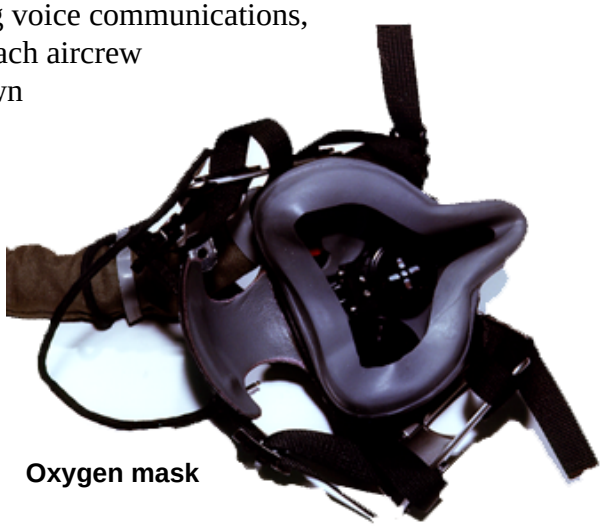
Flight Helmets and Oxygen Masks

Flight helmets fill several roles for NASA aircraft crewmembers. Helmets connect the oxygen mask to the pilots, protect them from noise, and provide protection for their heads in case of ground impact. Each helmet contains padded earphones that are linked to the aircraft's radio system. Microphones are built into the crewmembers' oxygen masks, which fasten to the helmets, completing the communications circuit.



Aircrew member with helmet and mask

Along with providing voice communications, oxygen masks give each aircrew member his or her own supply of oxygen to breathe when the aircraft flies at high altitudes, where the air is thinner and contains less oxygen than on the ground. The mask receives oxygen through a strong flexible hose connected to an on-board pressurized oxygen tank and flow regulator system. NASA regulations require every person flying in unpressurized aircraft above 10,000 feet or at night to use oxygen, so properly working masks are necessary on most flights at Dryden.



Oxygen mask

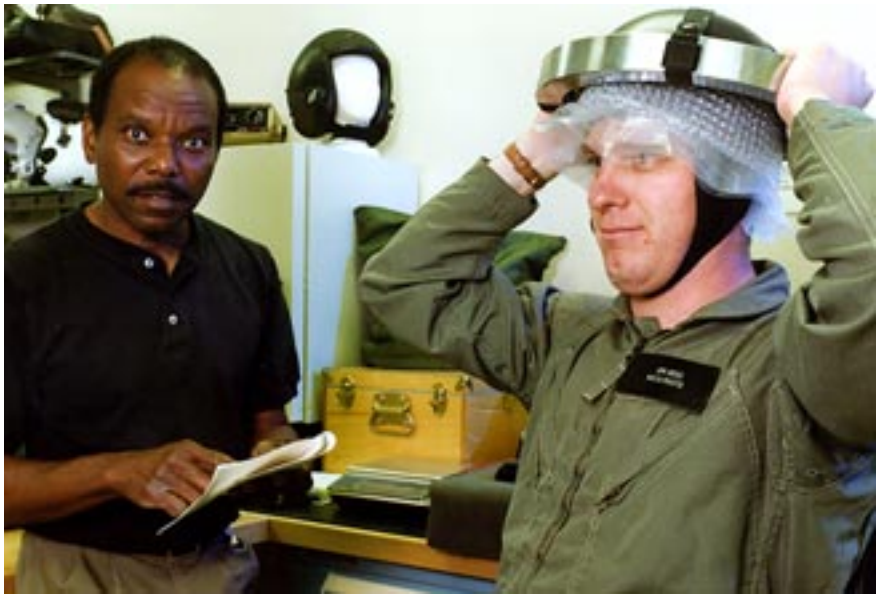
Two special visors are also built into helmets and can be lowered over the eyes individually. One is a clear visor that provides eye protection during emergency situations; the other is tinted and used just like sunglasses. The tinted visor also provides the same measure of eye protection as the clear visor during emergencies.

Helmets are custom-fitted to each crewmember. During the fitting process, a thick plastic liner that slides into the helmet shell is softened with heat and placed on the individual's head. As the liner cools, it conforms to the shape of the person's head for a permanent custom fit. A properly fitted helmet assures comfort and safety during all flight regimes.

All helmets at Dryden are carefully checked by branch personnel every 30 days. They are cleaned and inspected to make sure they are 100% serviceable before the helmet is reassembled. Visors are checked for perfect visibility and replaced if they have been scratched.

Oxygen masks are disassembled, inspected, cleaned, and disinfected every month. Microphones are given a communications check and the reassembled mask is tested for proper oxygen flow before it goes back to the pilot's locker.

Branch personnel also inspect and maintain the aircraft oxygen system.



Custom fitting a helmet

Flight Clothing

Flight clothing issued and maintained by the Life Support Equipment Branch begins with the one-piece flight suits on which names and colorful project patches are usually sewn. The suits are made of a fire-retardant material as an added measure of safety.

For additional comfort in cold weather, flight crews can wear long-legged and long-sleeved undergarments supplied by the branch. These items are made of 100% fire-resistant cotton. If a crewmember chooses to wear his or her own undergarments, they too must be made of 100% cotton or fire-retardant material.

Flight boots and gloves, also made of fire-retardant materials, round out the list of clothing items used in routine NASA flight operations.

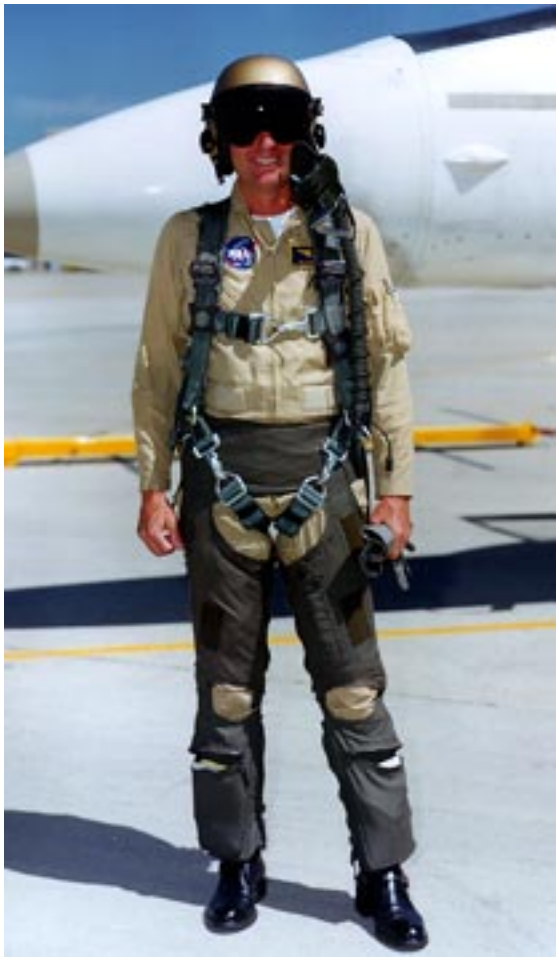
Each article of clothing is inspected for serviceability by the wearer before each flight. Flight clothing is always laundered separately to keep it free of flammable fibers.

Anti-G Garments (G-Suits)

The G-suit is one of the most important articles of flight equipment used in high performance aircraft everywhere. This is the term for suits which help prevent pilots and crewmembers from losing consciousness, or "blacking out," when their aircraft maneuvers and exceeds the force of gravity by several times or more.

A G-suit resembles a pair of cowboy chaparejos (chaps) and fits snugly around the lower abdomen and legs. It contains air pockets sewn into the multi-layered fabric. A small hose leads from the garment to an air regulator system in the cockpit. During flight, the air regulator system inflates the G-suit when the force of two Gs (twice that of gravity) or more is reached. The inflated G-suit tightens around the person's lower body and legs to prevent the fast flow of blood from the head and upper body into the lower body, which causes partial or full "blackouts." Once the G force passes, the G-suit deflates and remains in a neutral condition until pressure is needed again.

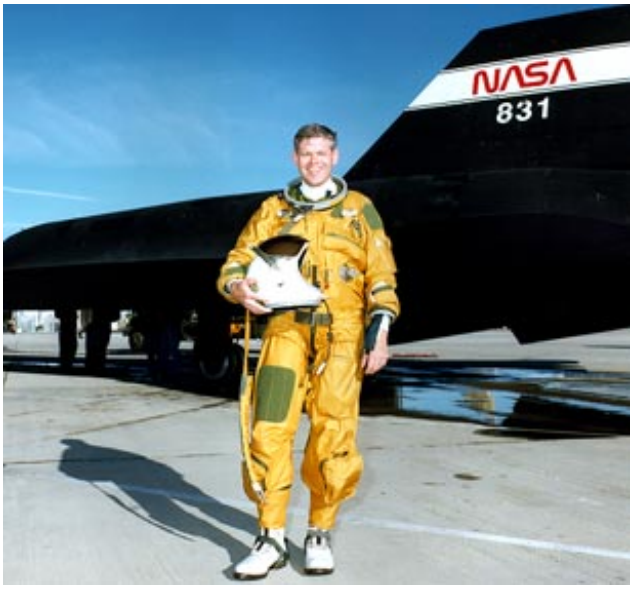
Modern aircraft such as the F-16 and F-16XL, both of which are flown at Dryden for research and support missions, can exert up to nine Gs — nine times the force of gravity — on pilots and crewmembers. Under these conditions, humans need a device like the G-suit to remain conscious and in control of their aircraft.



Flight suit, torso harness, and G-suit

Life support equipment experts at Dryden inspect and test each G-suit once every 120 days. They look for signs of fabric wear and make sure the hook-up and lacing systems fasten properly. During the inspection process, each garment is inflated and must maintain 5 pounds of pressure for at least one minute or it is replaced.

SR-71 Full Pressure Suits



SR-71 pressure suit

Pilots and crewmembers who fly in NASA SR-71 aircraft at Dryden wear flight suits that are much like astronaut spacesuits. Called full pressure suits, they provide an individual, self-contained "capsule" of air pressure and oxygen to breathe because the SR-71 cockpits are not pressurized to low-altitude conditions.

Full pressure suits apply a low-altitude pressure on the body so that normal breathing and blood flow can continue at very high altitudes. The air pressure and oxygen are furnished from systems on board the aircraft.

The suits, with their integrated helmet systems, are maintained by the U.S. Air Force physiological support personnel at Edwards AFB, while the aircraft life support systems are maintained by NASA's Life Support Equipment Branch personnel.

Parachute Systems

Parachutes and parachute torso harnesses are perhaps the most important items on the list of life support equipment for NASA flight crewmembers. They are rarely needed, but must perform properly when called upon.

Parachutes for all of the F-15, F-16, and F-18 aircraft flown at Dryden are installed in the ejection seat and remain in the aircraft. Pilots and crewmembers wear adjustable harnesses which are attached to the ejection seat once they are in the aircraft. If a pilot or crewmember must leave the aircraft in an emergency, the ejection seat system propels him or her away from the aircraft and the parachute deployment system unfurls the 28-foot diameter parachute automatically. These parachute systems are inspected monthly to make sure all the components are serviceable. Once each year the parachutes are unpacked, aired out, and carefully repacked after a close inspection. Parachutes used by NASA and military forces are packed and folded by licensed parachute riggers only.

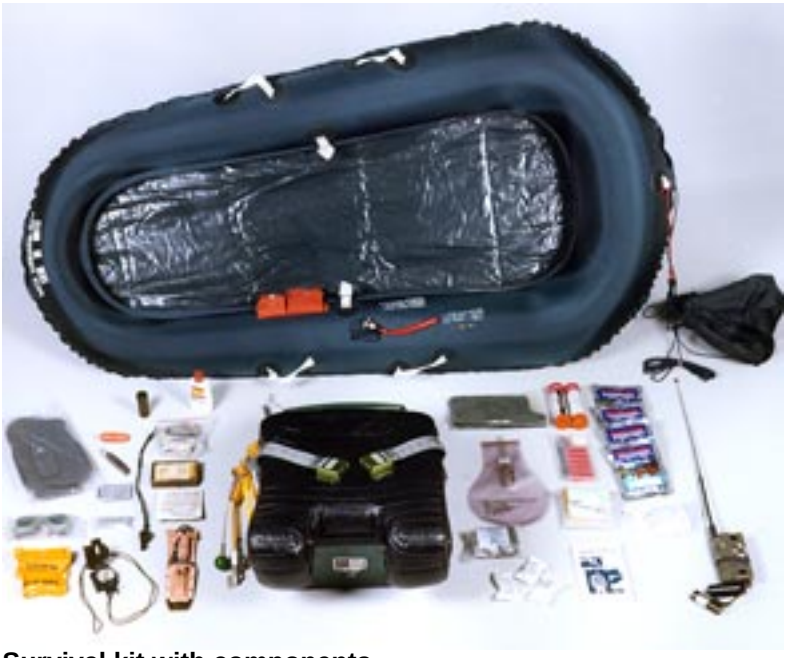
Parachute harness assembly

Pilots and crewmembers of other aircraft at Dryden, such as the NASA B-52, strap into parachutes that are prepositioned in the aircraft. This type of parachute is unpacked, aired out, and repacked by a licensed parachute rigger every 180 days.

Harnesses and parachutes receive a close visual inspection by branch staff every 30 days.

Survival Kit

Each type of ejection seat system comes with a survival kit. Among the items the kits contain are a fixed-frequency radio, whistle, mirror, flares, matches, survival blanket, raft repair plugs, compass, first aid kit, knife, snakebite kit, food rations and water, and a locator beacon to alert search and rescue units. The kits are inspected every 180 days and dated items are restocked when necessary. Part of the individual survival package is a small, inflatable, one-person life raft, which is also inspected, inflated, and repacked every six months.



Survival kit with components

Survival Training

The Life Support Equipment Branch conducts emergency and survival training for everyone who flies in an aircraft at Dryden.

The schooling covers the proper use and care of flight clothing and equipment; how to safely hook up to the aircraft systems; cockpit familiarization; emergency ground egress; how to eject from an aircraft; parachuting and landing techniques; water survival; survival first aid; and survival techniques using the items in the survival kit. All crewmembers, including pilots, receive survival training every six months. Crewmembers who are not experienced in survival skills receive the training every 30 days until a satisfactory level of proficiency is achieved.

Water survival training

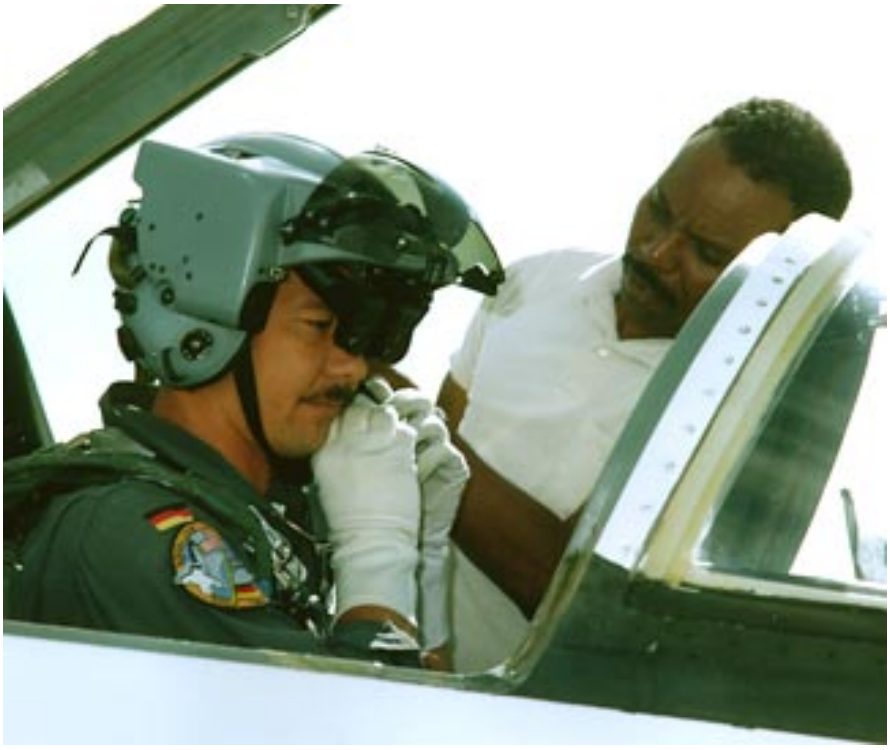
Survival training for NASA flight crews also includes bi-annual water survival training. This training is conducted at Lake Isabella, near Kernville, CA, northwest of Edwards AFB. While in the water, crewmembers learn how to free themselves from parachutes and other equipment, inflate and get into rafts, and how to be extracted safely from the water by helicopter crews and other rescue personnel.

Test and Development Work

The Life Support Group in past years has helped test and evaluate new items of flight equipment, or modifications to existing items.

The Life Support Group evaluated a flight helmet for the Department of Defense. It featured an internal system to project onto the visor the Heads-Up Display (HUD) symbology normally displayed in front of the pilot on the cockpit console. HUD symbology includes aircraft speed, altitude, and attitude references, and also tactical targeting information if the aircraft has a weapons system.

The Dryden Life Support Group evaluated the helmet's compatibility with aircraft ejection systems and pilot comfort.



Viper helmet

Experience

Most NASA life support equipment personnel received their formal training and experience in one of the military services. This training includes knowledge of the various items of flight equipment and clothing, and also expertise in survival training and human physiology as it pertains to the respiratory system.

The life support equipment field is so specialized that few aerospace companies offer on-the-job or entrance-type training for young men or women seeking this line of work.

Math and general science, plus physiology, are subjects that would aid anyone seeking entrance into or already working in the life support field.